**Antecedents and consequences of eating and their role in obesity.**

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A report submitted as a partial requirement for Masters of Clinical Psychology at the University of Tasmania, 2013.

*I declare that this report is my own original work and that contributions of others have been duly acknowledged.*

*Signature:*..... ..... *Date:*.....30/4/14.....

**Acknowledgements**

It is with great appreciation that I thank my supervisors, Dr. Stuart Ferguson and Dr Ben Schüz for their invaluable guidance throughout the course of this project. Thank you both for your time, patience, and support every step of the way.

To the members of the Behavioural and Situational Research Group, thank you all for your input and feedback, you have been a fantastic team to work with. Special thanks to Mai Frandsen, Isabelle Morris, and Chiara Paganini for helping with recruitment and data collection in both Hobart and Launceston.

I would also like to express my gratitude to all those who gave their time to participate and make this study possible.

Finally, thank you to my family and friends for all your understanding and encouragement. To Brent Kink, you have been my rock and I am forever grateful for your unconditional support and motivation.

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# Antecedents and consequences of eating and their role in obesity.

**Jodie Bower**

## Abstract

The aim of this research thesis was to provide a preliminary examination of the contextual antecedents and psychological drivers of individual eating patterns, and explore the relationship between these patterns and mechanisms that mediate body mass index (BMI). Two related studies focussed on the frequency of snacking behaviour, particularly consumption of energy-dense foods (Study 1), and the role of stimulus dependence and hedonic response in maintaining snacking behaviour (Study 2). Using Ecological Momentary Assessment (EMA) methodology, data were collected from 53 participants representing a range of BMI. For 10 consecutive days, participants were asked to log every instance of eating and drinking that occurred and to respond to survey questions about the situational context of eating episodes. Although the average snacking frequency was low overall, a relatively large proportion of food consumed was energy-dense, and higher BMI was shown to be significantly associated with increased frequency of snacking. Stimulus dependent (i.e. cue-driven) eating did have a role in participants' eating patterns, compared to hedonic (i.e. reward-driven) response which was not found to influence future eating decisions. However, neither of these eating motives was found to be associated with baseline BMI. These results give valuable insight into the complexity of individual eating patterns, and have important implications for weight management interventions and national health outcomes.

## General Introduction

Eating behaviour in humans is a complex process modulated by a combination of internal psychological processes and environmental influences (Volkow & Wise, 2005). Historically, humans consumed food primarily for survival through the maintenance of energy homeostasis (Lowe & Butrym, 2007). However, recent obesity rates suggest that eating now commonly occurs well beyond any biological need for nutrients. In addition to clinical conditions, the reasons why certain individuals chronically overeat are unclear but may reflect differences in conditioned associations between certain foods and neural reward circuitry (e.g. Berridge, Ho, Richard, & DiFeliceantonio, 2010; Volkow & Wise, 2005); ability to exert inhibitory control over temptation of palatable food (i.e. impulsivity) (e.g. Berthoud, 2007); and/or an enhanced sensitivity to a food-rich environment (e.g. Davis, Strachan & Berkson, 2004).

In Australia, 37% of adults are overweight (body mass index (BMI) $\geq$ 25-30 kg/m) and one-in-four can be classified as obese (BMI $\geq$30kg/m) (ABS, 2009). Being overweight or obese increases an individual's chance of developing health conditions such as Type 2 diabetes, cardiovascular diseases, musculoskeletal disorders, and some cancers (WHO, 2013). Obesity is closely linked to modifiable risk factors such as an unhealthy diet/overeating and insufficient physical activity (WHO, 2013). This suggests that the incidence of obesity-related conditions is largely preventable. Australia has one of the highest rates of obesity in the developed world (ABS, 2009); research aimed at understanding and reducing this obesity epidemic is of substantial clinical importance.

### The emergence of 'hedonic hunger'

Food intake is regulated by two complimentary drives known as the homeostatic and hedonic pathways (Lutter & Nestler, 2009). Historically, research on eating regulation assumed that food intake is controlled almost entirely by homeostatic feedback mechanisms

which increase the motivation to eat when energy stores become depleted (i.e., true 'hunger'; Lutter & Nestler, 2009). From an evolutionary perspective, fat is seen to be survival fuel used to avoid starvation when food sources are scarce, while sugar helped keep individuals alert to potential dangers (Hobbs, 2008). In this context, a dynamic equilibrium of energy was likely to be maintained using behavioural and metabolic regulatory processes to correct for deviations in energy intake in either direction.

It is well known that the fundamental cause of obesity is caloric imbalance: consuming more energy than is expended (WHO, 2013). Although the forces underlying this imbalance are multifaceted, it is widely acknowledged that food consumption in excess of basic nutritional requirements are characteristic of modern Western cultures, a trend which has led to inevitable weight gain within these populations (Hobbs, 2008). As evidenced by the rise in obesity statistics (ABS, 2009), homeostatic regulatory processes alone are obviously not sufficient to adequately correct for such strong disparities in energy intake and expenditure.

Thus, it is now recognised that the homeostatic pathway can be overridden and that eating beyond satiety (or 'fullness') can be attributed to a wide variety of non-physiological factors including cultural and social influences, environmental factors and psychological motives such as pleasure/reward, boredom, stress, and negative mood (Lutter & Nestler, 2009). This has led to the suggestion of a new dimension of appetite, known as 'hedonic hunger' which Lowe and Butrym (2007) describe as a subjective perception of hunger driven by the automatic processing of food-related cues such as the smell or sight of food, or food-related cognitions. Latent hedonic appetitive motives are believed to respond to exposure to these food-related cues by influencing psychological processes (e.g. thoughts, feelings, motivations) which create a strong drive to eat, irrespective of energy needs (Lowe & Butrym, 2007). Thus, the reasons why we eat have changed over time, leading to a modern

paradox whereby both the absence and presence of food can stimulate 'hunger', albeit of different kinds (Lowe & Butrym, 2007).

Modern developments in food technologies have allowed the creation and modification of certain foods to artificially enhance their rewarding properties (i.e. taste/palatability; Gearhardt, Grilo, DiLeone, Brownell, & Potenza. 2011). Such foods are typically high in fat, sugar, salt, flavours, and/or food additives and have been described in the literature as 'hyperpalatable' (Gearhardt et al., 2011). Abundance of such foods contributes to what has been termed an 'obesogenic environment': an environment that promotes weight gain by facilitating increased energy intake (in food and beverages) and/or reduced energy expenditure (i.e. sedentary lifestyles and opportunities to save labour such as supermarkets, fast food outlets, and drive throughs; Thornley, McRobbie, Eyle, Walker, & Simmons, 2008). There is abundant evidence that preference for and consumption of hyperpalatable foods is positively correlated with BMI (Davis, et al., 2004; Lowe & Levine, 2005; Thomas, Doshi, Crosby, & Lowe, 2011). This change in physical environment has therefore had a powerful influence on human eating behaviour.

The social environment also has a significant impact on patterns of food consumption. Eating-related cognitions and behaviours are shaped by the norms and expectations embedded within a particular cultural context (Lowe & Butrym, 2007). For example, many social gatherings involve participation in food consumption, and social convention prompts us to eat at certain times of the day with snacks in-between (Hobbs, 2008).

**Psychological processes underlying stimulus dependent eating**

Why we eat, as well as what, when, and how much food is consumed is ultimately determined by the psychological processes underlying how we respond to both our physical and social environment. It is now well established that the mechanisms through which hyperpalatable foods lead to excessive consumption involve reward centres in the brain that

create powerful incentives for eating (Berridge et al., 2010; Volkow & Wise, 2005). The pervasiveness of hedonic hunger in the modern psyche highlights that an increasing proportion of food consumption is being driven by the pleasurable or rewarding properties of food rather than its energy content (Lowe and Butrym, 2007).

Eating behaviours driven by food-related cues are known in the literature as stimulus dependent eating. Individuals may misinterpret their psychological responses to both internal and external food-related cues as signals of biological hunger (Lutter & Nestler, 2009). External cues may include seeing or smelling food, seeing other people eating, food advertising, or exposure to the time/location where that food has previously been consumed. Internal cues refer to psychological desires either to experience highly palatable tastes, or to lessen negative mood states, particularly sadness, stress, boredom, and anger (i.e. 'emotional/comfort eating').

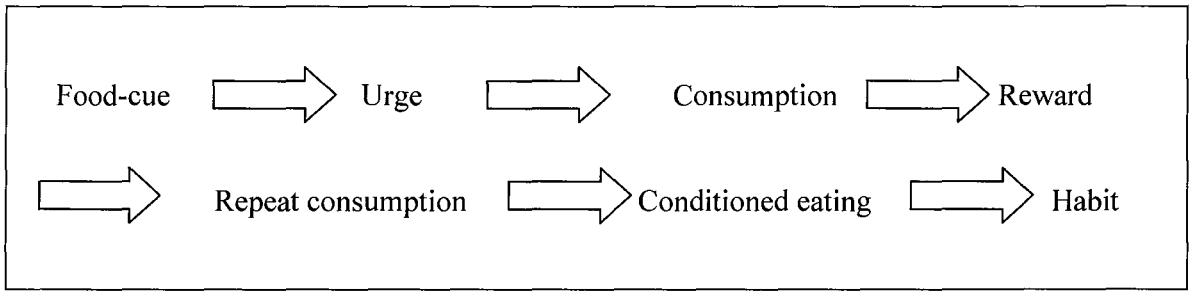


Figure 1. The relationship between food-related cues and conditioned eating (Based on Berridge et al., 2010; Thornley et al., 2008; Volkow & Wise, 2005).

Constant exposure to food-related cues can trigger a cycle of conditioned eating (see Figure 1). Dopaminergic pathways in the midbrain are responsible for responding to food-related cues by generating an emotional response (i.e. the perception of 'wanting') which stimulates anticipation of reward and motivates approach behaviour towards obtaining that food (Berridge et al., 2010). Acting on this urge induces release of opioids (endorphins) and

creates the experience of 'liking' the food. Opioid circuitry is the body's primary pleasure system and in this context, 'liking' refers to the hedonic impact or experience of pleasure that is central to the reward experience. Thus, engaging opioid mechanisms enables the body to perceive the consumption experience as rewarding and drives us to keep eating.

Humans have an inherent drive to seek out and repeat behaviours they find pleasurable/rewarding (Weiten, 2004). Consistent with principles of operant conditioning, learning circuitry in the brain remembers cues that predict food reward so the next time that cue is encountered, the dopamine response motivates the individual towards consumption. Repeated exposure to the rewarding experience reinforces the approach behaviour and strengthens the association between the cue and reward (Volkow & Wise, 2005). Over time, cues that predict the food become as important in the food-seeking behaviour as the food itself (i.e. become a classically conditioned stimulus) and can trigger food cravings, overeating, and an increased preference for hyperpalatable foods (Blumenthal & Gold, 2010). Thus, the appetitive motive driving hedonic hunger is shaped by learned response habits and neurobiological adaptations in brain reward circuits (Berridge et al., 2010; Thornley et al., 2008; Volkow & Wise, 2005).

Ifland et al. (2009) describe stimulus dependent eating as pleasure seeking followed by 'mindless' behavioural reinforcement. When familiar food stimuli activate well-established neural pathways, action schemata develop that trigger a known behavioural response based on the conditioned association. In this way, liking of the stimulus becomes a less important drive of eating, as our behavioural responses to strongly ingrained food cues become an automatic habit. Thus, conditioning mechanisms can explain incidences of over-consumption experienced as involving loss of control (e.g., increased portion size, binge eating, increased snacking frequency). As an extension of this reinforcement effect, growing evidence supports shared neurobiological pathways and similarities in neurochemical responses between

hyperpalatable foods and addictive drugs (e.g. cocaine, heroin), suggesting common hedonic mechanisms may underlie both obesity and drug addiction. (e.g. Filbey, Myers, & DeWitt, 2012; Gearhardt, Corbin, & Brownell, 2009; Johnson & Kenny, 2010).

Food consumption can either be driven by positive reinforcement (i.e. eating for taste/pleasure) or negative reinforcement (i.e. eating to reduce psychological distress). A common example of the latter is comfort/emotional eating. Research suggests that eating is often used as a form of self-medication in response to negative emotional states such as depression, anxiety, loneliness, boredom, anger and interpersonal conflict (Davis, Strachan, & Berkson, 2004). The rewarding affects of certain hyperpalatable foods (e.g. chocolate) are experienced by some as having a momentary hedonic calming effect (Davis et al., 2004). Repeated use of such foods to deal with these psychological states reinforces that behaviour and habits develop to the point where even if the rewarding properties of the food themselves aren't technically changing mood, the enactment of the learned behaviour response does.

**Individual differences and the Power of Food Scale**

Patterns of chronic overeating appear to reflect psychological adaptations to living in a modern obesogenic environment. However, it is clear that not everybody exposed to obesogenic environments will develop maladaptive psychological connections to food and experience weight gain; some individuals are better able to eat according to their body's energy needs, or are more efficient at compensating their food intake with exercise (See Drummond, Crombie, Cursiter, & Kirk, 1998). Thus, it is likely that there are meaningful individual differences in the strength of hedonically based motivations to eat.

Several risk factors have been identified in the literature as influencing an individual's susceptibility to developing the patterns of conditioned associations to hyperpalatable food discussed above. Volkow and Wise (2005) acknowledge the role of genetic and biological predisposition and assert that variability in BMI may be attributable to the complex

interaction between this vulnerability and the individual's environmental experience. Overweight and obese individuals have been found to experience an enhanced sensitivity to food rich environments and be more responsive to reward and punishment (Davis et al., 2004; Davis et al., 2008). Research by Davis et al. (2004) found overweight subjects were significantly more sensitive to reward than those of normal weight and thus more likely to approach hyperpalatable food and derive pleasure from consumption. In contrast, obese subjects were low in reward sensitivity. This finding was interpreted as suggesting hedonically driven overeating over time causes down-regulation of mesolimbic dopamine availability leading to anhedonia, or reduced ability to experience pleasure from natural reinforcers (consistent with Johnson & Kenny's (2010) neurobiological research above).

Similarly, a recent study by Thomas et al. (2011) found that the incidence of overeating for heavier individuals increased as a direct function of the number of palatable foods available in the immediate environment, compared to leaner individuals who reported a relatively low frequency of overeating regardless of palatable food availability. It was concluded that those with higher BMI are more sensitive to the presence of palatable food in their environment and are more likely to rely on external cues to decide when to start and stop eating; normal-weight individuals are more able to rely on biological cues such as feelings of hunger and satiation. Thus, eating behaviour of individuals with relatively higher BMI could be more stimulus dependent than those of lower BMI. Thomas and colleagues concluded that future research should work towards replicating the patterns of externally motivated eating observed in their study, and further specifying the psychological mechanisms responsible for this behaviour.

Sensitivity to the presence of hyperpalatable food and its associated reward is mediated by another key personality trait involved in modern eating behaviours: self-control. The omnipresence of appealing food requires the frequent need to inhibit the desire to eat

(Berthoud, 2007). Hofmann and colleagues suggest that ability to exert inhibitory control over temptation to eat reflects individual differences in personality measures of behavioural inhibition and behavioural activation (Carver & White, 1994; Hofmann, Baumeister, Förster, & Vohs, 2012). From this point of view, normal weight individuals are just as susceptible to temptation, but are better at restraining their impulse for hedonic fulfilment (Berthoud, 2007; Hofmann et al., 2012).

To assist with measurement of individual differences in hedonic hunger, Lowe et al. (2009) developed the Power of Food Scale (PFS). The PFS is designed to measure the power of food over individuals living in a food-abundant environment by assessing their appetite-related thoughts, feelings, and motivations. This scale takes a shift in the perspective from differences in individuals in their reactions to food to differences in food to differentially affect individuals' behaviour. PFS scores are able to tap into both major risk factors discussed above by measuring psychological temptation rather than physiological need, as well as sensitivity and vulnerability to the hedonic aspects of the food environment.

**The relationship between eating patterns and obesity**

Eating patterns are an important contributing factor to BMI. Particularly for those individuals who are more sensitive to hedonic food cues, the persistent temptation of hyperpalatable foods is likely to impact both the frequency and quantity of food consumption. Just as individual eating habits influence personal weight gain, cultural norms and eating patterns are likely to be a significant force behind population weight increases in the context of our reward-rich food environment.

Eating events have typically been categorised as either main 'meals' or 'snacks' (Ovaskainen et al., 2006). As mentioned above, for many years most people in modern society have conformed to the traditional pattern of eating three main meals per day (i.e. breakfast, lunch, dinner; Bisogni et al., 2007). This meal structure is a modern cultural

construct that has become standardised over time due to social factors such as traditional work schedules and traditional family life (Bisogni et al., 2007).

The concept of snacks is more complex and the frequency of snacking episodes between meals is subject to a lot more variability. Using primarily dietary recall surveys, the majority of studies conducted in the 1980s and 1990s supported the standard three meals per day structure and show that both adults (e.g. Bellisle. McDevitt, & Prentice, 1995) and children (e.g. Cross. Babicz. & Cushman, 1994; Ezell, Skinner, & Penfield, 1985) have an average snacking frequency of 2-3 times daily. Most people tended to consume at least one snack per day, while some have reported an eating frequency that includes up to 8 snacks in a day (e.g. Ezell, et al., 1985).

The accuracy of dietary intake studies may be significantly influenced by the type of definitions used; there is no definitive description of what constitutes a 'meal' and a 'snack'. Researchers have tended to rely on physiological/quantitative definitions typically relating to energy content or time of eating, however these categorizations do not necessarily coincide with colloquial, cultural, or individual perceptions (Gatenby, 1997). Several studies have highlighted these conflicting classifications and their impact on the outcomes and interpretations of dietary research (e.g. Gatenby et al., 1995; McBride et al., 1990). McBride et al. (1990) found that relationships between energy intake and eating frequency were dependent on what constituted a meal; a correlation between eating frequency and energy intake was only significant when 'meals' were defined as consumption of more than 375kJ in one sitting.

For this reason, researchers need to be clear to participants about the definition to use. Gatenby (1997) and Ovaskainen (2006) both recommend sticking to more general definitions since descriptions that are too specific tend to be restrictive and are vulnerable to under-reporting (under-reporting discussed in more depth later). These authors summarise the most

common definitions by describing 'meals' as one of the main eating events of the day, usually occurring at morning (breakfast), mid-day (lunch), and evening (dinner); whereas 'snacks' generally refer to the smaller, unstructured eating events occurring in between meal consumption.

Such definitions, and even the terms 'meals' and 'snacks' themselves, may be becoming less suitable as eating patterns are changing. Ovaskainen et al. (2006) used 48-hour computer-assisted dietary recall to collect data from 2007 adults in Finland. They found that daily energy was derived predominantly from main meals however a snack-dominating meal pattern was observed in one fifth of men and one quarter of women (Ovaskainen et al., 2006). It was concluded that main meals in the 2000's are still the primary source of dietary energy, however an increasing amount of energy (36% in men, and 40% in women in this study) is now being derived from snacks between main meals (Ovaskainen et al., 2006).

Thus, it appears that snacking is becoming increasingly common in today's society. It is also possible to interpret these results as suggesting that the distinction between meals and snacks has become increasingly blurred. For example, several authors have reported difficulty discriminating emerging terms such as 'light meals' from 'snacks' (Ovaskainen et al., 2006; Poulain, 2002). With the emergence of 'obesogenic products' becoming entrenched in our modern lifestyle (Hobbs, 2008), now any time of day can be a time to eat; our lifestyles no longer fit the traditional eating schedule and we are seeing an emergence of a 'snacking culture' where we are increasingly likely to eat on the move or snack frequently ('grazing') rather than sitting down to three square meals a day (Hobbs, 2008). For this reason, there is a growing trend in dietary intake research to use alternative terms such as 'eating occasions/events/episodes' in place of the now somewhat out-dated constructs of 'meals' and 'snacks'.

There is also controversy in the literature relating to whether increased eating frequency is linked to higher BMI. Most snacks are eaten irregularly as spontaneous additions to the diet (Gatenby, 1997) and are typically higher in energy density and lower in nutrient content (Gearhardt et al., 2011). Intuitively, it makes sense that consistently having a high eating frequency over a period of time will increase body mass. Indeed, increased eating frequency has been found to be associated with decreased body weight control (Kirk, 2000) and obesity (Forslund et al., 2005). In Ovaskainen et al.'s (2006) research, both men and women with a snack-dominating meal pattern had higher intakes of energy, alcohol, sugars, and sucrose and lower intake of several micronutrients. Similarly, Hampl, Heaton, and Taylor (2003) found the increasing frequency of snacks to correlate positively with total energy intake.

**Measuring food consumption**

Previous studies of the food environment and individual eating behaviour have tended to rely on retrospective self-report (e.g., questionnaires and clinical interviews) (e.g. Lowe et al., 2009), written food diaries (e.g. Tuomisto, Tuomisto, Hetherington, & Lappalainen, 1998), and laboratory experimentation and/or observation. However, the validity of these methodologies is affected by certain fundamental biases and potential inaccuracies. For example, results from laboratory studies cannot necessarily be generalised to the natural environment due to difficulty emulating the relatively transient emotional, psychological, and social states which influence eating behaviour (Smyth et al., 2001).

These contextual factors also have the power to distort the reconstructive process of autobiographical memory recall. As discussed earlier, Ifland et al. (2009) recognise that incidences of over-consumption are often experienced as effortless, habitual events in response to negative emotional states; the mindless nature of this behaviour can later lead to unwitting errors in estimated recall of eating frequency and/or portion size (Smyth et al., 2001). Incidences of conscious misreporting of energy intake can also occur due to social

desirability and motivational influences (Maurer et al., 2006). Systematic errors in energy reporting have been shown to occur more often according to certain demographic characteristics, including BMI; those with higher BMI are more likely to report lower carbohydrate intake, lower fat intake, and omit snacks between meals (e.g. Johansson, Solvoll, Bjorneboe & Drevon, 1998).

Ecological Momentary Assessment (EMA) is specifically designed to overcome retrospective recall biases and issues relating to ecological validity. EMA data collection involves using technological devices such as programmed wrist watches, pagers, or hand-held computers to gather repeated assessments of current (or very recent) activities, situations, thoughts, feelings, or behaviours within the individual's natural environment and in as close to real time as possible (Ferguson & Shiffman, 2011; Smyth et al., 2001). EMA has been increasingly used in health behaviour research for the study of a wide range of both psychological and physical phenomena including eating disorders: Binge Eating (Grange et al., 2002; Stein et al., 2007; Wegner et al., 2002), Bulimia (Smyth et al., 2001), Anorexia Nervosa (Burd et al, 2009).

EMA technology has also been used to study non-clinical eating behaviours. For example, recent research by Thomas et al. (2011) used palmtop computers to investigate the interaction between person-specific factors and environmental factors in the prediction of episodes of overeating. Thirty nine female participants (mean age ± 20), all within the normal BMI range (i.e. 18-25) carried an EMA device for 7-10 days and responded to semi-random prompts asking questions about recent eating events/opportunities, including a count of the types of good tasting high-calorie foods that were available; whether they ate more than usual, the same as usual, or less than usual during the eating episode; as well as indicating their mood and their current level of dietary restraint. The authors recommended that their study be refined and replicated by extending the population to include overweight/obese participants

and further exploring their finding of increased stimulus dependent eating by those who were of relatively higher BMI.

**Rationale and hypotheses**

How eating-related cognitions and behaviour may affect energy intake and contribute to the occurrence of overeating and obesity is still poorly understood. Recent literature suggests the omnipresence of hyper-palatable food in modern environments is linked to eating patterns characterised by chronic overconsumption, particularly increased frequency of snacking (Hobbs, 2008; Thornley et al., 2008). It has been argued that BMI is strongly related to individual differences in sensitivity to the rewarding properties of energy-rich foods and the degree of stimulus dependent eating in response to both internal (e.g. affect) and environmental (e.g. social situation) antecedents (e.g. Davis et al., 2004; Thomas et al., 2011;Volkow & Wise, 2005). Understanding the psychological mechanisms behind overeating has important implications for weight management interventions and national health outcomes.

This project examines eating patterns and behavioural responses to food-related cues in two related studies. The aim of Study 1 was to provide a descriptive summary of participant's eating patterns and how these patterns relate to an individual's BMI. Study 2 was designed as an examination of the relationship between these patterns and mechanisms that mediate BMI. The hypotheses that relate to these aims were that (1) snacking is more stimulus dependent in participants with higher baseline BMI scores, as indicated by a larger area under the curve for the receiver operating characteristic (AUC-ROC) explained by stimuli; (2) hedonic response (i.e. averaged satisfaction and pleasantness ratings) will be positively correlated with shorter time periods between snacking and subsequent eating episodes; and (3) average hedonic response will be positively related to baseline BMI scores. In addition, a secondary aim was to study the viability of EMA methodology to study eating patterns and underlying motives.

## Study 1: Eating Patterns Descriptive Study

### Introduction

Study 1 involves a descriptive summary of participants' eating patterns and an exploration of how these patterns relate to BMI. Literature suggests that the meal structure of modern society is changing; the distinction between meals and snacks has become blurred and the frequency of snacking in particular has been identified as one of the many contributing factors to increasing rates of obesity observed in the last decade (e.g. Hobbs, 2008; Ovaskainen et al., 2006). Eating patterns are typically studied using methodology such as questionnaires, clinical interviews, and written daily food diaries, which are vulnerable to error and bias inherent in retrospective self-reporting (see Smyth et al., 2001 for a review). These issues can be overcome using alternate data collection methodologies that gather information in as close to real-time as possible; however further research is needed to clarify reporting compliance and validity. Thus, Study 1 results were also used to assess the viability of using EMA methodology as a means to gather self-reported data about eating patterns.

### Method

**Design.** This study follows a longitudinal, field-based, observational design.

**Participants.** Fifty-six participants were recruited via flyer advertisements (Appendix A) distributed throughout the University of Tasmania; an advertisement on the School of Psychology webpage (Appendix B); and through placement of an advertisement (Appendix C) on the Facebook® social media website. A brief telephone screening survey was used to determine eligibility for the study. Selection criteria included that the individual be over 18 years of age; have no history of an eating disorder; and not be currently dieting (i.e. not actively trying to change their eating habits during this time).

One participant withdrew from the study within the first day due to difficulty understanding the assessment protocol (despite standardised training; see below). Data from a

further two participants were excluded from analyses; one was identified as a univariate outlier (regarding weight) and another due to poor EMA compliance (defined as completing <50% of random assessments). This left the evaluable sample of 53 participants. Participants were predominantly young Caucasian adults, and represented a broad range of BMI. See Table 1 for baseline demographics. Baseline weight and BMI scores are presented in Table 2. This study received approval from the Human Research Ethics Committee (Tasmania) Network (H0012474; see Appendix D).

**Baseline survey.** The baseline survey (Appendix E) included demographic information and questions regarding eating habits (e.g. frequency of dining out or consumption of fast-food/take-away food). The baseline survey also included a food frequency questionnaire and the Power of Food Scale (PFS; Lowe et al., 2009). As described earlier, the PFS is a brief measure of appetite-related thoughts, feelings, and motivations, as well as sensitivity and vulnerability to the hedonic aspects of the food environment. As part of a larger study, other scales were also included that are not reported here.

Table 1. Demographic variables across participants

| Variable | Value |
|---|---|
| Age (years) | |
| Range | 18 – 60 |
| Mean ± SD years | 28.17 ± 11.15 |
| Gender - % (n) | |
| Female | 41.51% (22) |
| Education - % (n) | |
| Year 10 or less | 1.89% (1) |
| Year 12 | 18.87% (10) |
| Some university | 33.96% (18) |
| Graduated university | 43.40% (23) |
| No answer | 1.89% (1) |
| Ethnicity - % (n) | |
| Caucasian/European | 75.47% (40) |
| Asian | 13.21% (7) |
| No answer | 9.43% (5) |
| Aboriginal | 1.89% (1) |
| Power of Food Score (Mean ± SD) | 2.67 ± 0.81 |

*Note:* n= number of participants; SD= standard deviation

Table 2. Baseline Weight and Body Mass Index (BMI)

| Variable | Value |
|---|---|
| Weight (kg) | |
| Range | 48.70 – 99.40 |
| Mean ± SD | 68.58 ± 12.71 |
| Body Mass Index (BMI) | |
| Range | 17.70 – 37.00 |
| Mean ± SD | 23.90 ± 4.14 |
| Underweight (BMI <18.5) - % (n) | 1.89% (1) |
| Healthy weight (BMI = 18.5-24.9)-% (n) | 64.15% (34) |
| Overweight (BMI = 25-29.9) - % (n) | 24.53% (13) |
| Obese (BMI >=30) - % (n) | 9.43% (5) |

*Note:* n= number of participants; BMI= Body Mass Index ($kg/m^2$); BMI category cut points derived from Ardern, Janssen, Ross & Katzmarzyk (2004).

**Assessment procedure**. At Visit 1, an information sheet (Appendix F) was provided to participants before they indicated informed consent by completing the consent form (Appendix G). Participant's contact details were then recorded, followed by completion of the baseline survey. Following completion of the baseline survey, measurements of participant's height and weight were physically measured by a study staff member (for calculation of BMI). All participants were then provided with a smartphone (see Figure 2) that had been stripped of its native functionality to run EMA software specialised designed for the study and received individual training on how to use the monitoring device. Participants were asked to carry the EMA device during the waking hours of the day for ten consecutive days and log every instance of eating and drinking (described in detail below). This initial enrolment visit took approximately 45 minutes.

Visit 2 occurred 2-3 days into the study. During this brief visit (~10-15 minutes), participants' data was uploaded from their study device and reviewed using study-specific compliance checking software, to ensure they had been using the device and adhering to study protocol. This visit included re-training and troubleshooting as necessary. EMA monitoring concluded at Visit 3 (~20 minutes), on or around day 10 of the study. The study device was returned to the researcher and all data archived on a secure server. Participants who completed the study received $40 as compensation for their time and contribution to the study.

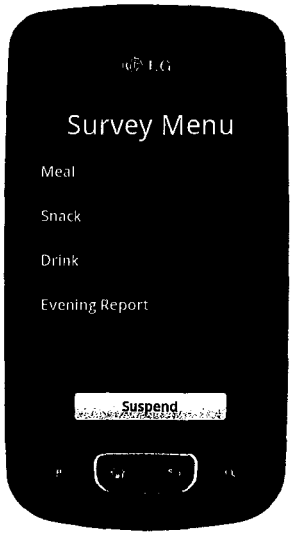


Figure 2. Example of an EMA monitoring device used in the current study.

**EMA monitoring.** Assessment scheduling was based on previous EMA studies of eating (e.g. Thomas et al., 2011) and smoking (e.g. Shiffman, 2009) habits. See Appendix H for EMA program questions. As part of full assessments, participants were asked to complete ratings of their current mood (e.g. bored, stressed, sad) and energy level, as well as an assessment of contextual and situational details (e.g. location, availability of food, current activity, presence of social influences). Structured assessment responses (no open-ended text) consisted of one of several types: (a) quantitative responses (mood and craving) on a 0-100

point sliding visual analogue scale, where subjects moved a pointer along a line to indicate their response; (b) quantitative responses on a 0-10+ scale (c) responses that required selecting a single alternative (e.g., yes/no, or current location); (d) qualitative responses that allowed selecting multiple responses (e.g., at breakfast, one could be consuming a combination of different foods). The device algorithm also implemented skip patterns that allowed more detailed inquiry of endorsed responses; e.g., participants who said they were working were asked to further characterize the nature of the work. Participants could not go back to prior items to edit responses. Assessment data were date- and time-stamped, and uploaded to a server at subject visits.

Throughout the monitoring period, subjects engaged in event-oriented monitoring of energy consumption, being instructed to record their energy intake by pressing a button on the touch-screen device immediately before they consumed a meal, snack, or drink. A meal was defined as one of the three main meals of the day (breakfast, lunch dinner). A snack was defined as any item of food eaten between these main meals. A drink was defined as any liquid intake, excluding water. Besides recording energy intake in real-time, participants had two opportunities (at waking and bedtime) to report any food/drink that they had consumed but had not reported in real time ('confessed events'). The circumstances of these event occasions were not assessed and their timing is not known. These entries were counted in daily totals when assessing distribution of energy intake by day of week. Additionally, end-of-day assessments ('evening reports') required a quantitative retrospective estimate (similar to 'daily diary' methodology) of the amount of meals, snacks, and drinks consumed over the day for later comparison with real-time data. Evening reports also gathered global reports on daily mood, craving, exercise, and instances of restraining themselves from eating.

To avoid excessive burden, while all real-time events were recorded, only a subset were selected for full assessment. For each event logged, the participant was required to specify

whether it was a meal, snack, or drink (see Figure 2). Logged meals were then categorised as breakfast, lunch, or dinner, and then further specified according to the type(s) of food consumed (e.g. for breakfast: bread, cereal, eggs, yoghurt, fruit, meat, other). All logged meals progressed through the full assessment structure. To enable assessment of stimulus dependent eating, probability sampling was used to assess reported snacks according to their frequency and energy content. Once a snack was logged, it was then further specified by snack type (i.e. fruit/nuts, savoury, confectionary, fast food, biscuits/cakes/pastries, dairy, other). Energy-rich snacks (namely, confectionary, biscuits/cakes/pastries, or fast food) were tallied separately to other snacks; for each tally, the first three snacks that day were always sampled, after which the sampling probability reduced to 50%. If the daily snacking frequency rose to seven or more, then probability of full assessment was reduced further to 20%. The device algorithm used the same probability structure to over-sample energy-rich drinks (e.g. caffeine, alcohol, 'energy drink').

The device was also programmed to prompt (via an auditory or vibration alert signal) participants on average 3-5 times per day for randomly selected non-eating assessments ("random prompts"). Random prompt surveys paralleled eating-initiated assessments with the addition of questions reflecting on their most recent eating occasion. For example, how long ago did the last eating event occur; was it satisfying; was it enjoyable/pleasing; did they overeat (i.e. consume more than usual, as much as usual, less than usual); and are they currently craving more food but resisting the temptation to eat. Participants were given up to five minutes to respond to the random prompt survey before it was recorded as 'missed'.

This protocol was active during the entire waking day (though participants were given an option to "suspend" assessments during times when they were unavailable for assessments (e.g. while driving, in meetings, etc). Instances of eating could still be entered during these times but they only logged and never assessed. Participants were instructed to shut down the

device at bedtime and to switch the device back on upon waking. All data analysis was conducted using JMP statistics package (Version 10).

## Results

**Description of EMA monitoring**. Overall, EMA data was collected over 638 days of monitoring. Consistent with previous EMA studies, we excluded from analysis individual days when poor compliance was observed (defined as answering <50% of random prompts; 5.80% of monitored days). This left an evaluable sample of 601 participant-days of observation (mean of 12.04 days per person, *SE* = 0.29). Participants completed an average of 13.78 hours (*SE* = 12.75) of monitoring per day. A total of 2057 random prompts were issued over the course of the study; an average of 3.42 prompts (*SE* = 0.08) per participant per day; 93.00% (*n* = 1870) of these random prompts were completed within the allotted time window.

**Eating Patterns**. A total of 1327 meals were reported during monitoring (*M* = 2.29 per day; Range= 0 - 5; *SE* = 0.04). 46.03% of participants consumed three meals per day (i.e. breakfast, lunch, and dinner). Breakfast (n = 406) typically included cereal (44.83%), bread (38.42%), and/or fruit (20.83%); approximately a quarter (25.06%) of breakfast were reported using the 'other' category option. Lunch (*n* = 441) was typically a sandwich (37.87%), pasta (14.06%), or salad (14.71%); however 44.72% of all lunches were accounted for by the 'other' option. Dinner (*n* = 480) was typically meat (59.79 %), vegetables (49.38%) and/or pasta (39.00%), with 26.25% being reported using 'other'. Fast food accounted for 9.52% of reported lunches and 9.15% of dinners. Across participants, breakfast was typically consumed at 9.20am (*SE* = 5.87 minutes); lunch at 1.38pm (*SE* = 4.38 minutes); and dinner at 7.36pm (*SE* = 4.52 minutes). There was no correlation between BMI and daily frequency of meals ($r = 0.11$, $p = 0.45$). There was also no significant correlation between maximum number of meals per day and scores on the PFS (Spearman's rho = 0.21, $p = 0.12$).

A total of 1064 snacks were reported during monitoring ($M$ = 1.80 per day; Range= 0-10; $SE$ = 0.07). Almost half (43.46%) of reported snacks were energy-dense (defined as confectionary, biscuits, or fast food). The 'other' option accounted for 10.33% of reported snacks. Energy-dense snacks were most likely to be consumed in the afternoon, at 3.48pm ($SE$ = 7.08 minutes), although there was substantial variation with snacks reported over the course of the waking day. There were significant positive associations between BMI and a participants' average number of overall snacks per day ($r$ = 0.37, $p$ = 0.01) and maximum number of snacks per day ($r$ = 0.36, $p$ = 0.01). Snacking frequency was also positively correlated with the number of meals consumed per day ($r$ = 0.42, $p$ = <0.00). Among those participants who reported eating any energy-dense snacks during the monitoring period ($n$ = 45), daily average consumption of energy-dense snacks was significantly associated with BMI ($r$ = 0.44, $p$ = 0.00); however this relationship was substantially weaker ($r$ = 0.31, $p$ = 0.03) when participants who did not report any energy-dense snacking were included in the analysis. In addition, maximum number of snacks per day was positively – but not significantly - related to scores on the PFS ($r$ = 0.24, $p$ = 0.08).

A total of 1535 drinks were reported during monitoring ($M$ = 1.40 per day; range = 0-10; $SE$ = 0.06). Over a third (45.92%; $n$ = 705) of reported drinks were energy-dense (i.e. caffeine, alcohol, or energy drinks). Average frequency of energy-dense drink consumption was not significantly related with BMI ($r$ = 0.22, $p$ = 0.12).

On average, participants reported less than one 'confessed' meal ($M$ = 0.11; $SE$ = 0.02), snack ($M$ = 0.14; $SE$ = 0.02), and/or drink ($M$ = 0.30; $SE$ = 0.04) per day over the course of the monitoring period. Accuracy of end-of-day recording was assessed by comparing events recorded in real-time to events recorded in the retrospective tallies reported in the evening report. Participants' real-time EMA recordings of snacks and meals were closely related to recall in the evening report; snacks had a mean difference of 0.20 ($SE$ = 0.07) from evening

report recording and meals had a mean difference of 0.07 ($SE$ = 0.05). Drinks were also closely related between real-time and retrospective reporting (mean difference of 1.25; $SE$ = 0.09), with some incidences of over-reporting occurring in the evening report. Overall, across participant days there was a strong positive correlation between events reported in real-time and events reported retrospectively in the evening report for meals ($r$ = 0.37, $p$<.001), snacks ($r$ = 0.65, $p$<.001), and drinks ($r$ = 0.49, $p$<.001). However, the discrepancy between real-time and evening report data significantly correlated with BMI for snacks ($r$ = 0.20, $p$<.001), but not for drinks ($r$ = 0.00, $p$=.23) or meals (r = 0.00, $p$ = 0.67).

**Discussion**

**Eating patterns**. Participants' eating patterns in the present study were assessed by analysing the timing and frequency of meals, snacks, and drinks. Traditionally, modern society meal structure has tended to conform to the cultural norm of three meals per day (i.e. breakfast, lunch, dinner) (e.g. Bisogni et al., 2007). Recent literature suggests that this pattern is changing towards more frequent consumption of snacks during the day in place of large main meals (e.g. Bisogni et al. 2007; Hobbs, 2008). Our results do not support this finding; people who had a higher snacking frequency were also more likely to eat more meals. Although during standardised training a 'meal' was defined as 'one of the three main meals of the day', meal frequencies ranged from zero to five meals per day. On the surface, this could be consistent with Ovaskainen et al.'s (2006) suggestions that increased snacking results in a shift in perception of what constitutes a meal. However, although the number of snacks reported per day ranged from zero up to ten, the average snacking frequency reported was only 1-2 snacks ($M$ = 1.80) per day. In the present study, the average number of meals consumed was two per day with less than half the sample (46.03%) consuming the traditional three meals per day. This observation could be interpreted as participants skipping a meal (e.g. due to busy lifestyle) with additional support for this conclusion coming from

substantially lower frequency counts of reported breakfast meals ($n$ = 406), compared to lunch ($n$ = 441) and dinner ($n$ = 480).

In summary, it appears that the average person reported only consuming two meals per day and 1-2 snacks. Thus, in contrast to recent literature (e.g. Bisogni et al., 2007) there does not appear to be a high snacking frequency reported at the expense of main meals. This relatively conservative eating frequency may be attributable to the sample comprising predominantly of participants from within the normal/healthy range of BMI (i.e. BMI =18.5-24.9; 64.15%). According to recent literature discussed earlier, individuals within this weight range are likely to regulate their eating according to homeostatic processes (i.e. true hunger) rather than being driven to consume additional energy (i.e. snacking) due to hedonic motives (e.g. Gearhardt et al., 2011; Lowe & Butrym, 2007) (this hypothesis is explored in more detail in Study 2, below).

Alternatively, low eating frequency may also be indicative of under-reporting; although this appears unlikely in this study considering the real-time energy log and end-of-day retrospective recall match very closely and on average less than one 'confessed' meal/snack/drink was reported per day. Further, literature using methodologies based on retrospective reporting (e.g. Johansson et al., 1998; Macdiarmid & Blundell, 1998; Maurer et al., 2006) has suggested that under-reporting of snacks in particular is more commonly associated among those with increased BMI; however this EMA study showed a significant relationship between snacking frequency and BMI, suggesting that our participants appear to be being honest with their real-time reporting. Importantly, it was found that the discrepancy between real-time and evening report data increased with BMI for snacks and drinks, but not for meals. This suggests that increased BMI is associated with likelihood to report snacks and drinks in real-time but systematically under-report in the Evening Report (i.e. those with higher BMI were more likely to censor their answers during retrospective recall).

Recent research regarding modern eating patterns has also suggested that changes in lifestyle and environment are contributing to increased consumption of energy-dense foods (e.g. Hobbs, 2008). In the present study, 43.46% of reported snacks and 57.92% of drinks were energy-dense and these were most likely to be consumed in the afternoon (i.e. for an extra energy boost around 4pm). In regards to the energy content of meals, 'fast food' in particular accounted for nearly 10% of all reported lunches (9.26%) and dinners (9.02%). Consistent with Ovaskainen et al. (2006), these results suggest that main meals are still a fundamental source of dietary energy and nutrients, however a significant proportion of additions to our diets such as snacks and drinks are energy-dense.

**Relationships with BMI.** Although the average snacking frequency was low overall, results show that higher BMI was significantly associated with increased frequency of snacking. However this relationship did not hold when specified to frequency of energy-dense snacks in particular. Self-reported incidences of over-eating did not correlate with BMI. Importantly, increased BMI was associated with stronger tendencies towards preoccupation with food (as measured by the Power of Food Scale). Consistent with research by Lowe et al. (2009), those with higher BMI are more likely to experience appetite-related thoughts, feelings, and motivations, as well as sensitivity and vulnerability to the hedonic aspects of the food environment.

**Viability of using EMA to study eating patterns.** Overall, current results show that EMA is a viable way to gather accurate observations of individual's patterns of energy consumption. Participants had high compliance levels with data collection protocol (93.00% average compliance rate), and importantly the majority of events were recorded in real-time rather than 'confessed' at the end of the day. This compliance is comparable with previous studies utilising other methodology (e.g. Tuomisto et al., 1998). Thus, EMA appears to be at

least as accurate as other event recording methodology (e.g. daily diaries), with the advantage of additional qualitative information being gained about the context of energy consumption.

EMA is a relatively new data collection method and as such, there remain some limitations and suggested improvements. Important nutrition factors related to BMI include type of food (e.g. energy-dense), eating frequency, and portion size; this study design required participants to log eating events before they occur which limited its ability to gain an estimation of the latter beyond irregular self-reporting of overeating estimates during random prompts. In regards to the type of food recorded, the Westernised options of food categories limited the ability to capture food choices of non-western participants (approximately 25% of the sample was non-Caucasian); and the 'other' category option was used to log a substantial number of meals (32.01% overall) and snacks (10.33%). Reflecting on compliance with device protocol, the length of hours per day the device was turned on and the timing of breakfast in particular (approximately 9am) may suggest the device was not turned on immediately on waking and some eating instances may have been recorded ad-hoc.

## Study 2: Stimulus Dependence and Hedonic Response

### Introduction

Study 2 involved an examination of the psychological motives behind participant's eating patterns. Berridge & Robinson (2003) describe a conditioning process whereby exposure to food-related cues creates a sense of 'wanting' and subsequent consumption creates sensations of 'liking', which drives further eating. This model fits with a growing body of literature which asserts that for certain individuals, eating behaviour is strongly stimulus dependent; that is, exposure to food-related antecedents influences psychological processes (e.g. thoughts, feelings, motivations) which create a strong drive to eat, irrespective of energy needs (Lowe & Butrym, 2007). Research has shown that the eating behaviour of individuals with higher BMI is more likely to be under a stronger degree of stimulus control (e.g. Davis et al., 2004; Thomas et al., 2011; Volkow & Wise, 2005). This study tests this relationship by determining whether knowing antecedents such as current affect, location, activity, and social situation are useful predictors of snacking behaviour and whether this differs with BMI. This study also assessed whether hedonic response (i.e. 'liking') to the rewarding properties of food is associated with an increased frequency of snacking (i.e. likelihood of eating again sooner after a pleasing snack), and whether this relationship is more likely among those with higher baseline BMI.

### Method

**Participants and Procedures.** See Methods section for Study 1.

**Data Analysis**. Based on grouping analyses used by Shiffman & Paty (2006), four contextual antecedent variables (affect, location, social setting, activity) were created by collapsing lower-level variables into broad domains (see Table 3). Current state was assessed using 14 items derived from the circumplex model of affect (Russell, 1980). Individual adjectives were presented on-screen, one item at a time and answered using a slider (e.g.,

Happy? No!! – Yes!!). Responses to the individual items were then converted to z-scores (within-subject; $M = 0$, $SD = 1.00$), and using a principal component factor analysis (using oblimin rotation), two factors were extracted which were interpreted as affect and arousal. A substantial correlation ($r = -0.53$, $p < .001$) between these factors suggested to form a single antecedent variable subsequently termed 'affect/arousal'.

Table 3. Break-down of antecedent variables from lower-level variables

| Antecedent variable | Lower-level variables |
|---|---|
| Affect/arousal | Alert, angry/frustrated, calm/relaxed, able to focus, happy, irritable, stressed, sad, restless |
| Location | Home, Workplace, Other's home, Bar, Restaurant, Vehicle, Outside, Other |
| Social Setting | Alone, family, friends, co-workers, acquaintances, romantic partner |
| Activity | Working/chores, Inactive/leisure, Interacting with others, Between activities, Other activities |

To assess stimulus dependent eating, a two-level analysis was performed paralleling previous work exploring stimulus control in smoking behaviour (see Shiffman & Paty, 2006). First, for each participant logistic regression analysis was used to predict snacking (vs. non-eating/random prompt) events using blocks of situational antecedents as independent variables. Next, the resulting AUC-ROC values were used to predict BMI from the continuous independent variables in regression models. The magnitude of AUC-ROC reflects the degree to which snacking is predictable, independent of which particular variables

(antecedents) were predictive. AUC-ROC range from 0.5 (chance identification) to 1.0 (perfect identification). AUC-ROC can be interpreted as the probability of correctly identifying a snacking observation from a randomly chosen pair of snacking and not-snacking observations, given the predictor variables (Hanley & McNeil, 1982). That is, if AUC-ROC is 0.75, this means that in all possible pairwise comparisons of a snacking observation, the model would enable correct identification of the snacking observation 75% of the time.

To test hypotheses regarding hedonic response, participants were asked during random-prompts to rate the pleasantness ("Was the food/drink enjoyable/pleasing?") of their most recent eating episode and their satisfaction ("Was the food/drink satisfying?") on a scale of 0-100. The two ratings were highly correlated ($r = 0.75$); accordingly, these were averaged to form a single 'hedonic response' variable. Hedonic response ratings were used to predict the time interval between participants' eating episodes.

**Results**

**Stimulus dependence.** The strongest predictor of snacking was found to be current activity with this model being able to correctly determine if a participant is snacking 74% of the time (see Table 4). Knowing current social situation allowed accurate prediction of snacking 69% of the time; location 67% of the time; and affect/arousal 67% of the time. The degree of stimulus dependence for situational antecedents did not significantly vary across BMI (all $p$-values > 0.44).

Table 4. Mean (*SE*) area under the curve for the receiver operating characteristic (AUC-ROC) scores for models 1-4.

| Model (Predictors entered) | AUC-ROC |
|---|---|
| 1 (Affect/arousal) | 0.66 (0.02) |
| 2 (Location) | 0.68 (0.01) |
| 3 (Social Setting) | 0.69 (0.01) |
| 4 (Activity) | 0.74 (0.01) |

## Discussion

**Stimulus dependence.** Overall, the hypotheses regarding the relationship between BMI and stimulus dependent eating were not supported. This study focussed on four main contextual antecedents: affect/arousal, location, social situation, and activity. All antecedent variables were found to predict incidence of snacking at higher than chance levels. The strongest predictor of snacking was found to be current activity (73.51% of ROC-AUC explained), followed by social situation (69.28%), location (67.78%), and affect/arousal (67.48%). However, the degree of stimulus dependence for situational antecedents did not significantly vary according to BMI.

Interestingly, the power of using social situation to predict snacking varied depending on scores to baseline PFS scores. This was a negative association, seemingly reflective of the conclusion that the more hooked the participant is on food, the less helpful knowing their social situation is to determine whether they are likely to be snacking. This finding could be interpreted as showing that those who self-report a strong degree of appetite-related thoughts, feelings, and motivations in response to living in a food-rich environment are likely to engage in snacking regardless of their current social context; in comparison, those who feel that food

has less power over them are perhaps more sensitive to social influences on their likelihood of snacking (i.e. eating because others around them are eating).

An additional minor finding was that the ability of location to predict snacking varied with increasing age. It was observed that the older the participant, the more reliable knowing their location was in predicting whether they are snacking. Snacking appears to be more closely linked with certain locations for older age groups, whereas for younger participants (predominantly students in the present sample) snacking was spread widely over various locations.

Present results did not replicate those by Davis et al (2004, 2008) and Thomas et al. (2011); no evidence was found to support the hypothesis that higher BMI is associated with an enhanced sensitivity to the rewarding properties of food inherent in modern environments. Therefore stimulus controlled eating behaviour is not a differentiating factor in explaining obesity rates among our population. Alternative explanations are explored in more depth in the general discussion below.

**Hedonic Response and factors influencing time to next snack.** The second part of Berridge and colleague's (2003; 2010) conditioning process postulated that eating associated with the perception of 'liking' is more likely to drive the individual to eat again sooner to experience more reward. This process is thought to be especially characteristic of those individuals with higher BMI whose eating is believed to be more driven by 'hedonic hunger' reward motives rather than need for energy repletion (Lowe & Butrym, 2007). For the purposes of this study, hedonic response was measured as an average of pleasantness and satisfaction ratings of most recent snacking episode. In contrast to hypotheses based on Berridge et al.'s (2003; 2010) model, this study found no evidence for hedonic response having a role in predicting time to the next eating event. Further, there was no difference across BMI in the effect of hedonic response on eating behaviour.

Despite snacking being associated with a high level of pleasure and satisfaction, this hedonic experience was not a predictive factor in driving subsequent snacking episodes. It is

agreed that humans do have an inherent drive to seek out and repeat behaviours they find pleasurable/rewarding (Weiten, 2004). Thus, the above finding may be explained by variance; if all participants reported experiencing their chosen foods as pleasing and satisfying, there is no variance to predict time to next eating episode. Alternatively, the presence of food-related cues may be a more important determinant of snacking instances, compared to the hedonic response to previous snacking episodes. This latter conclusion is consistent with theories expressed by Ifland et al. (2009) who describe how conditioned associations between certain foods and neural reward circuitry reduce the importance of 'liking' of food as a driver for eating. That is, stimulus liking has an important role in the formation of stimulus dependent eating but not necessarily the maintenance of this eating pattern. In addition, consistent with stimulus dependence conclusions described above, hedonic responses to snacking do not provide insight into individual BMI.

Interestingly, participants scoring higher on the PFS did tend to report significantly shorter times between EMA-recorded eating episodes. Consistent with research by Lowe et al. (2009), there are clear individual differences in psychological responses to food and these differences have an important impact on snacking behaviour.

## General Discussion

The primary aim of this research thesis was to examine the science and psychology driving individual eating patterns and the influence of these mechanisms on BMI. This aim was designed to target the broader rationale of understanding which factors predict individual eating episodes and subsequently why Australians are facing high rates of preventable weight-related health conditions. Predictions were based on psychological models and theories regarding both antecedents (e.g. patterns of stimulus dependence) and consequences (e.g. hedonic responses) of eating. In contrast to initial hypotheses, snacking behaviour was not found to be more stimulus dependent in participants with higher baseline BMI scores.

Further, average hedonic responses to (hyper-palatable foods) were not significantly related to an increased frequency of snacking episodes (i.e. likely to snack again sooner) or baseline BMI.

**Eating Patterns.**

In the context of our modern 'obesogenic' environment, researchers have argued that the traditional pattern of three meals per day is being replaced by increased snacking frequency, particularly consumption of energy-dense ('hyper-palatable') foods (Bisogni et al., 2007; Hobbs, 2008; Thornley et al., 2008). This pattern was only partially supported by present results; our participants reported consuming an average of only two meals and 1-2 snacks per day, however a relatively large proportion of food consumed, particularly snacks (44% overall), was energy-dense. These results suggest that the quality of participants' diet is a bigger issue than their eating frequency.

**Impact of Situational Antecedents and Role of Stimulus Dependence**

As established above, snacking between meals is a common source of additional energy intake for many individuals; therefore, understanding the context preceding the decision to snack provides important insight into what factors are driving this behaviour. Consumption of energy-dense foods for reasons other than physical need for energy repletion is known as stimulus dependent eating (i.e. eating driven by environmental and/or psychological food-related cues; Lutter & Nestler, 2009). Our results show that stimulus dependent eating does have a role in population eating patterns; our four antecedent variables (affect, social situation, location, activity) were all shown to predict incidence of snacking at higher than chance levels. Consistent with Lowe and Butrym (2007), the tendency for hedonic hunger mechanisms to override homeostatic energy regulation is likely to be a common characteristic of today's eating patterns.

**Hedonic Responses to Snacking**

It can be equally insightful to explore the psychological consequences of snack consumption and their relationship with future spontaneous snacking. It is well documented in psychological literature that humans have an inherent drive to seek out and repeat behaviours they find pleasurable/rewarding (Weiten, 2004). However in this study, although participants reported a relatively high level of pleasure/satisfaction in response to snacking, their hedonic ratings were not related to shorter intervals to the next eating event. This finding reflects that there are other factors mediating this complex feedback process.

**The Role of Conditioned Eating in Snacking Patterns**

There are various models proposed to explain the role of neural reward circuitry in hedonic responses to food and subsequent increase in appetitive drive and approach behaviour towards repeat consumption. As illustrated in Figure 1 earlier, complex conditioning processes are believed to underlie maintenance of hedonic-based snacking patterns (Berriedge et al., 2010; Pelchat, 2009; Thornley et al., 2008; Volkow & Wise, 2005). Using Berridge et al.'s (2010) framework, dopaminergic pathways in the brain are believed to create a sense of 'wanting' in response to certain internal (e.g. affect) and external (e.g. social setting) food-related cues. This is consistent with present results finding that situational antecedents such as affect, location, social setting, and activity are important predictors of snacking. Food consumption, especially of energy-dense snacks, was often experienced as pleasurable/rewarding by our participants, reflective of Berridge et al.'s (2010) sense of 'liking' which is related to opioid (endorphin) release.

However, in contrast to predictions under this framework (Berridge et al., 2010), perceiving the experience as hedonically rewarding was not reliably associated with repetition of behaviour. It appears that conditioning mechanisms have created learned associations with food-related cues and snacking responses over time, but this conditioning is

more strongly linked with initiation of snacking behaviour rather than inducing frequent repetition.

**Relationships with BMI**

The present results did not replicate those by previous researchers (e.g. Davis et al., 2004; Thomas et al., 2011; Volkow & Wise, 2005) who found the eating behaviour of individuals with higher BMI to be more dependent on external stimuli. Although increased BMI was associated with higher baselines scores on the PFS scale, these subjective self-reports were not corroborated by real-time behaviour patterns. Most importantly, the power of antecedent variables (affect/arousal, social situation, activity, location) to predict snacking was not related to BMI. Therefore stimulus controlled eating behaviour is not a differentiating factor in explaining obesity rates among our population.

**Limitations and Recommendations for Future Research**

The above studies support the viability of EMA methodology to examine motivations and patterns of eating within an individual's natural context. However several limitations were encountered. The majority of participants (65%) were within the normal/healthy BMI range; it is difficult to extrapolate meaningful conclusions regarding the eating behaviour of obese individuals from such a restricted sample range. When considering energy intake, it is important to consider food type (e.g. energy density), eating frequency, and portion size. However, this sample provided limited recordings of hyper-palatable (i.e. energy-rich) foods and the measure of 'overeating' used was quite subjective and proved difficult to draw meaningful conclusions from. Further, this research thesis narrowed its focus to assessment of energy intake however in order to gain holistic understanding of chronic energy imbalance, future research would ideally incorporate assessment of energy expenditure (i.e. physical exercise). In light of these limitations, it is recommended that this research be replicated and extended to a larger sample size and broader range of BMI with amendments in assessment

methodology designed give further insight into concepts such as portion size, overeating, and energy expenditure.

**Conclusion**

Individual eating patterns are influenced by a multitude of psychological, social, and situational factors. Consistent with research by Lutter and Nestler (2009), contextual antecedents such as affect/arousal level, current location, social setting, and activity were found to have an important role in driving eating motives. These factors appear to have an important effect on sense of 'wanting' and subsequent approach behaviour (Berridge et al., 2010). However, the subjective experience of 'liking' recently consumed food did not have a strong impact on motivation to engage in subsequent eating behaviour. This suggests that eating patterns are dominated by conditioned associations to food-related cues (Berridge et al., 2010; Blumenthal & Gold, 2010; Volkow & Wise, 2005), rather than a reactive process of reward-based overconsumption (as implied by theories of food addiction; Filbey et al., 2012).

However, neither stimulus dependence nor hedonic response alone was found to be significantly associated with baseline BMI. This reflects the multifaceted nature of eating and reinforces that there is no simple answer to why individuals gain weight. Current obesity rates and their health-related consequences (ABS, 2009) highlight the need to make weight management interventions more effective. Results from this research thesis strongly suggest that successful weight management requires an understanding of the contextual drivers and idiosyncrasies of individual eating patterns. Hedonic hunger appears to be largely habitual and underpinned by associations learned over time; therefore, reducing the cue-driven power of food in our modern 'obesogenic environment' (Thornley et al., 2008) may be achieved by assisting individuals to understand the conditioning process, recognise their vulnerabilities, and develop strategies for breaking the conditioned cycle of cue, consumption, and reward.

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## Table of Appendices

# Appendix A

## Flyer advertisement

# Why do we eat?

A research team at University of Tasmania are examining people's eating habits, and...**we need YOUR help!**

Picture via Flickr by Darwin Bell

***Are you..?***

- Aged **18** or over
- **Not currently on a diet** or attempting to change your eating habits

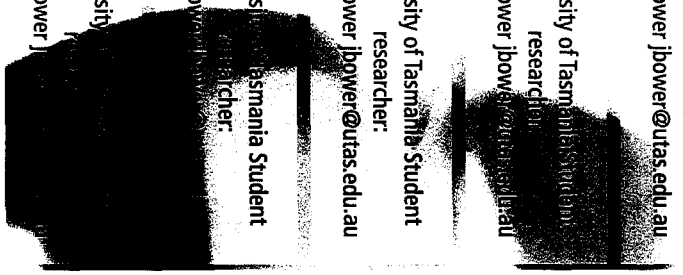
***Are you available to?***

- **Monitor** your food consumption over a ten day period using an easy to use mobile phone program
- Attend up to **three short visits** at the University of Tasmania Sandy Bay campus during these **ten days**

**You will be reimbursed up to $40 for your time**

***Want to know more?***

Contact Jodie Bower (Clinical Psychology Masters student) at **jbower@utas.edu.au**



University of Tasmania Student researcher:
Jodie Bower jbower@utas.edu.au

University of Tasmania Student researcher:
Jodie Bower jbower@utas.edu.au

# Appendix B

## Advertisement on the School of Psychology webpage

## Wording for webpage link

**ANTECEDENTS AND CONSEQUENCES OF EATING**

We are recruiting participants aged **18 or more** who are interested in contributing to research into eating patterns.

We don't know enough about why people eat. The purpose of this study is therefore to examine the situations in which people eat and how they are feeling at the time. The outcomes of this study may help to inform and improve future weight-management interventions.

Please click on the information sheet for more information.

**Research Participation Submission Form**

The School of Psychology welcomes your participation. Please complete and submit the form below. The output of this form goes to the project co-ordinator.

**Name:**

**Phone number:**

**Email address:**

**Additional comments:**

# Appendix C

## Advertisement on the Facebook® social media website

**WHY DO WE EAT?**

UTAS is looking for people to take part in research into eating patterns. You may be eligible to take part in this project. Compensation will be provided

# Appendix D

## Ethics Approval Letter

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

9 May 2012

Dr Stuart Ferguson
School of Pharmacy
University of Tasmania
Private Bag 26
Hobart Tasmania

Student Researcher: Jodie Bower

Dear Dr Ferguson

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0012474 - Antecedents and consequences of eating and their role in obesity**

---

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 3 May 2012.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Ethics Officer
Tasmania Social Sciences HREC

# Appendix E

## Baseline survey

**APPENDIX F**
**BASELINE SURVEY**
**[To be administered using Lime Survey software]**

**Baseline Survey**

1. **What is your current age?** (Type number of years)
2. **Gender?** (Male, Female)
3. **What is your ethnicity?** (check any that apply)
    - Caucasian/European
    - Aboriginal
    - Torres Strait Islander
    - Asian
    - Other (please specify)
4. **What is the highest level of education that you have completed?** (choose one of the following answers)
    - Year 10 or less
    - Year 12
    - Some University
    - Graduated University
    - Graduated at TAFE
    - No answer
5. **What is your current marital status?** (choose one of the following answers)
    - Living with partner
    - Married
    - Widowed
    - Separated
    - Divorced
    - Never Married
6. **Please estimate your current weight in kg:** (type number in box below)
7. **Please estimate your current height in cm:** (type number in box below)

**8. For each food listed, tick the circle indicating how often you typically consumed that food in the past 12 months. (*Please tick <u>one circle for each food listed</u>, even if you never eat it).***

| | | Never or less than once a month$_1$ | 1-3 times per month$_2$ | Once per week$_3$ | 2-4 times per week$_4$ | 5-6 times per week$_5$ | Once per day$_6$ | 2-3 times per day$_7$ | 4-5 times per day$_8$ | 6+ times per day$_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| a | Cakes, sweet muffins, scones or pikelets | O | O | O | O | O | O | O | O | O |
| b | Sweet pies or sweet pastries | O | O | O | O | O | O | O | O | O |
| c | Other puddings or desserts | O | O | O | O | O | O | O | O | O |
| d | Plain sweet biscuits | O | O | O | O | O | O | O | O | O |
| e | Cream or chocolate biscuits | O | O | O | O | O | O | O | O | O |
| f | Meat pie, sausage roll or other savoury pastries | O | O | O | O | O | O | O | O | O |
| g | Pizza | O | O | O | O | O | O | O | O | O |
| h | Hamburger | O | O | O | O | O | O | O | O | O |
| i | Chocolate (including chocolate bars e.g. Mars Bar™) | O | O | O | O | O | O | O | O | O |
| j | Other confectionery/lollies | O | O | O | O | O | O | O | O | O |
| k | Peanut butter, other nut spreads | O | O | O | O | O | O | O | O | O |
| l | Full-fat milk | O | O | O | O | O | O | O | O | O |
| m | Reduced-fat, low-fat or skim milk | O | O | O | O | O | O | O | O | O |
| n | Full-fat cheddar and other cheeses | O | O | O | O | O | O | O | O | O |
| o | Reduced-fat or low-fat cheddar and other cheeses | O | O | O | O | O | O | O | O | O |
| p | Full-fat ice cream | O | O | O | O | O | O | O | O | O |
| q | Reduced-fat or low-fat ice cream | O | O | O | O | O | O | O | O | O |
| r | Meat - beef, veal, lamb, pork or mince dishes | O | O | O | O | O | O | O | O | O |
| s | Meat - sausage, frankfurter, bacon, ham, salami | O | O | O | O | O | O | O | O | O |
| | Fish | | | | | | | | | |
| | Chicken | | | | | | | | | |
| | Fruit (apple, banana, berries etc) | | | | | | | | | |
| | Vegetables (carrot, cabbage, peas, potato etc | | | | | | | | | |

9. **For each type of beverage listed, tick the circle indicating how often you consumed that drink in the past 12 months. (*Please tick <u>one circle for each beverage listed</u>, even if you never drink it).***

| | Never or less than once a month[1] | 1-3 times per month[2] | Once per week[3] | 2-4 times per week[4] | 5-6 times per week[5] | Once per day[6] | 2-3 times per day[7] | 4-5 times per day[8] | 6+ times per day[9] |
|---|---|---|---|---|---|---|---|---|---|
| Tea | O | O | O | O | O | O | O | O | O |
| Coffee | O | O | O | O | O | O | O | O | O |
| Soft drinks (e.g. Cola) | O | O | O | O | O | O | O | O | O |
| Energy drinks (Red Bull, Mother etc.) | O | O | O | O | O | O | O | O | O |
| Fruit juice, flavoured cordial | O | O | O | O | O | O | O | O | O |
| Water | | | | | | | | | |
| Alcohol | | | | | | | | | |

10. **Do you do your own cooking/meal preparation at home?** (choose one of the following answers)
    - Rarely or none of the time
    - Some of the time (1-2 days per week)
    - Much of the time (3-4 days per week)
    - Most of the time (5-7 days per week)

11. **How often do you 'eat out' (e.g. at a restaurant/ café etc)?**
    - Rarely or none of the time
    - Some of the time (1-2 days per week)
    - Much of the time (3-4 days per week)
    - Most of the time (5-7 days per week)

**12. How often do you order 'take-away' or 'fast-food' (e.g. McDonalds, Hungry Jacks, Subway)?**

- Rarely or none of the time
- Some of the time (1-2 days per week)
- Much of the time (3-4 days per week)
- Most of the time (5-7 days per week)

**13. Do you typically experience food cravings**?

- Everyday
- Often
- Sometimes
- Rarely/never

**14. If yes, what type of food do you usually crave?** (confectionary, savoury, dairy, sweets/biscuits/pastries)

**15. [Adapted from Carver & White's (1994) BAS Reward Responsiveness subscale of the BIS/BAS scale]**

Please indicate how much you agree or disagree with the following items:

| | 1= Very true for me | 2=Somewhat true for me | 3=Somewhat false for me | 4=Very false for me |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| When I'm doing well at something I love to keep at it. | ○ | ○ | ○ | ○ |
| When I get something I want, I feel excited and energized | ○ | ○ | ○ | ○ |
| When I see an opportunity for something I like I get excited right away | ○ | ○ | ○ | ○ |
| When good things happen to me, it affects me strongly. | ○ | ○ | ○ | ○ |
| It would excite me to win a contest. | ○ | ○ | ○ | ○ |

**16. [Adapted from CES-D: Eaton, Muntaner, Smith, Tien,& Ybarra, 2004**

**For each of the following statements, please indicate if you felt this way during the past week. Tick the circle that best describes the extent to which you have felt this way.**

| | Rarely of none of the time (less than 1 day) | Some of the time (1-2 days) | Much of the time (3-4 days) | Most of the time (5-7 days) |
|---|---|---|---|---|
| I was bothered by things that usually don't bother me | ○ | ○ | ○ | ○ |
| I did not feel like eating; my appetite was poor | ○ | ○ | ○ | ○ |
| I felt that I could not shake off the blues even with help from my family and friends | ○ | ○ | ○ | ○ |
| I felt that I was just as good as other people | ○ | ○ | ○ | ○ |
| I had trouble keeping my mind on what I was doing | ○ | ○ | ○ | ○ |
| I felt depressed | ○ | ○ | ○ | ○ |
| I felt that everything I did was an effort | ○ | ○ | ○ | ○ |
| I felt hopeful about the future | ○ | ○ | ○ | ○ |
| I thought my life had been a failure | ○ | ○ | ○ | ○ |
| I felt fearful | ○ | ○ | ○ | ○ |

***For each of the following statements, please indicate if you felt this way during the past week. Tick the circle that best describes the extent to which you have felt this way.**

| | Rarely of none of the time (less than 1 day) | Some of the time (1-2 days) | Much of the time (3-4 days) | Most of the time (5-7 days) |
|---|---|---|---|---|
| My sleep was restless | ○ | ○ | ○ | ○ |
| I was happy | ○ | ○ | ○ | ○ |
| It seemed that I talked less than usual | ○ | ○ | ○ | ○ |
| I felt lonely | ○ | ○ | ○ | ○ |
| People were unfriendly | ○ | ○ | ○ | ○ |

| | | | | |
|---|---|---|---|---|
| I enjoyed life | ○ | ○ | ○ | ○ |
| I had crying spells | ○ | ○ | ○ | ○ |
| I felt sad | ○ | ○ | ○ | ○ |
| I felt that people disliked me | ○ | ○ | ○ | ○ |
| I could not get going | ○ | ○ | ○ | ○ |

## 17. Power of Food Scale- Lowe, M. (2006; see Cappelleri et al., 2009)

Power of Food Scale: Please indicate the extent to which you agree that the following items describe you. Use the following scale from 1 to 5 for your responses.

| | | *I don't agree* (1) | *I agree a little* (2) | *I agree somewhat* (3) | *I agree quite a bit* (4) | *I strongly agree* (5) |
|---|---|---|---|---|---|---|
| Q1 | I find myself thinking about food even when I'm not physically hungry | (1) | (2) | (3) | (4) | (5) |
| Q2 | I get more pleasure from eating than I do from almost anything else | (1) | (2) | (3) | (4) | (5) |
| Q3 | If I see or smell a food I like, I get a powerful urge to have some | (1) | (2) | (3) | (4) | (5) |
| Q4 | When I'm around a fattening food I love, it's hard to stop myself from at least tasting it | (1) | (2) | (3) | (4) | (5) |
| Q5 | It's scary to think of the power that food has over me | (1) | (2) | (3) | (4) | (5) |
| Q6 | When I know a delicious food is available, I can't help myself from thinking about having some | (1) | (2) | (3) | (4) | (5) |
| Q7 | I love the taste of certain foods so much that I can't avoid eating them even if they're bad for me | (1) | (2) | (3) | (4) | (5) |
| Q8 | Just before I taste a favorite food, I feel intense anticipation | (1) | (2) | (3) | (4) | (5) |
| Q9 | When I eat delicious food I focus a lot on how good it tastes | (1) | (2) | (3) | (4) | (5) |
| Q10 | Sometimes, when I'm doing everyday activities, I get an urge to eat 'out of the blue' (for no apparent reason) | (1) | (2) | (3) | (4) | (5) |
| Q11 | I think I enjoy eating a lot more than most other people | (1) | (2) | (3) | (4) | (5) |
| Q12 | Hearing someone describe a great meal makes me really want to have something to eat | (1) | (2) | (3) | (4) | (5) |
| Q13 | It seems like I have food on my mind a lot | (1) | (2) | (3) | (4) | (5) |
| Q14 | It's very important to me that the foods I eat are as delicious as possible | (1) | (2) | (3) | (4) | (5) |
| Q15 | Before I eat a favorite food my mouth tends to flood with saliva | (1) | (2) | (3) | (4) | (5) |

## 18. YFA-Scale (Gearhardt, Corbin, & Brownell, 2009)

**This survey asks about your eating habits in the past year. People sometimes have difficulty controlling their intake of certain foods such as:**

- **Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, ice cream**
- **Starches like white bread, rolls, pasta, and rice**
- **Salty snacks like chips, pretzels, and crackers**
- **Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries**
- **Sugary drinks like soda pop**

**When the following questions ask about "CERTAIN FOODS" please think of ANY food similar to those listed in the food group or ANY OTHER foods you have had a problem with in the past year**

| IN THE PAST 12 MONTHS: | Never | Once a month | 2-4 times a month | 2-3 times a week | 4 or more times or daily |
|---|---|---|---|---|---|
| 1. I find that when I start eating certain foods, I end up eating much more than planned | 0 | 1 | 2 | 3 | 4 |
| 2. I find myself continuing to consume certain foods even though I am no longer hungry | 0 | 1 | 2 | 3 | 4 |
| 3. I eat to the point where I feel physically ill | 0 | 1 | 2 | 3 | 4 |
| 4. Not eating certain types of food or cutting down on certain types of food is something I worry about | 0 | 1 | 2 | 3 | 4 |
| 5. I spend a lot of time feeling sluggish or fatigued from overeating | 0 | 1 | 2 | 3 | 4 |
| 6. I find myself constantly eating certain foods throughout the day | 0 | 1 | 2 | 3 | 4 |
| 7. I find that when certain foods are not available, I will go out of my way to obtain them. For example, I will drive to the store to purchase certain foods even though I have other options available to me at home. | 0 | 1 | 2 | 3 | 4 |
| 8. There have been times when I consumed certain foods so often or in such large quantities that I started to eat food instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy. | 0 | 1 | 2 | 3 | 4 |
| 9. There have been times when I consumed certain foods so often or in such large quantities that I spent time dealing with negative feelings from overeating instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy. | 0 | 1 | 2 | 3 | 4 |
| 10. There have been times when I avoided professional or social situations where certain foods were available, because I was afraid I would overeat. | 0 | 1 | 2 | 3 | 4 |
| 11. There have been times when I avoided professional or social situations because I was not able to consume certain foods there. | 0 | 1 | 2 | 3 | 4 |
| 12. I have had withdrawal symptoms such as agitation, anxiety, or other physical symptoms when I cut down or stopped eating certain foods. (Please do NOT include withdrawal symptoms caused by cutting down on caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.) | 0 | 1 | 2 | 3 | 4 |
| 13. I have consumed certain foods to prevent feelings of anxiety, agitation, or other physical symptoms that were developing. (Please do NOT include consumption of caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.) | 0 | 1 | 2 | 3 | 4 |
| 14. I have found that I have elevated desire for or urges to consume certain foods when I cut down or stop eating them. | 0 | 1 | 2 | 3 | 4 |
| 15. My behavior with respect to food and eating causes significant distress. | 0 | 1 | 2 | 3 | 4 |
| 16. I experience significant problems in my ability to function effectively (daily routine, job/school, social activities, family activities, health difficulties) because of food and eating. | 0 | 1 | 2 | 3 | 4 |

| IN THE PAST 12 MONTHS: | NO | YES |
|---|---|---|
| 17. My food consumption has caused significant psychological problems such as depression, anxiety, self-loathing, or guilt. | 0 | 1 |
| 18. My food consumption has caused significant physical problems or made a physical problem worse. | 0 | 1 |
| 19. I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems. | 0 | 1 |
| 20. Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure. | 0 | 1 |
| 21. I have found that eating the same amount of food does not reduce my negative emotions or increase pleasurable feelings the way it used to. | 0 | 1 |
| 22. I want to cut down or stop eating certain kinds of food. | 0 | 1 |
| 23. I have tried to cut down or stop eating certain kinds of food. | 0 | 1 |
| 24. I have been successful at cutting down or not eating these kinds of food | 0 | 1 |

| 25. How many times in the past year did you try to cut down or stop eating certain foods altogether? | 1 time | 2 times | 3 times | 4 times | 5 or more times |
|---|---|---|---|---|---|

26. Please circle ALL of the following foods you have problems with:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ice cream | Chocolate | Apples | Doughnuts | Broccoli | Cookies | Cake | Candy |
| White Bread | Rolls | Lettuce | Pasta | Strawberries | Rice | Crackers | Chips |
| Pretzels | French Fries | Carrots | Steak | Bananas | Bacon | Hamburgers | Cheese burgers |
| Pizza | Soda Pop | None of the above | | | | | |

27. Please list any other foods that you have problems with that were not previously listed:

# Appendix F

## Information sheet

**PARTICIPANT INFORMATION SHEET**
**SOCIAL SCIENCE/ HUMANITITES**
**RESEARCH**

**STUDY: ANTECEDENTS AND CONSEQUENCES OF EATING AND THEIR ROLE IN OBESITY**

**Invitation**
You are invited to participate in a research study into the drivers and consequences of eating. The study is being conducted by Masters of Clinical Psychology student Jodie Bower, supervised by Dr Stuart Ferguson from the School of Pharmacy and Dr Ben Schüz from the School of Psychology.

**1. 'What is the purpose of this study?'**
The purpose of this study is to investigate weight management from the "input" perspective, focusing on the drivers and consequences of eating, and in particular the consumption of energy-dense foodstuffs (e.g., fast food, energy drinks). Data will be gathered on the psychological (e.g. cravings, mood), social, and situational antecedents of an eating episode, as well as on people's feelings *after* consuming energy-rich foods. Results from this research have the potential to influence the development of more efficacious weight management interventions in the future.

**2. 'Why have I been invited to participate in this study?'**
You are eligible to participate in this study because you are over 18 and interested in contributing to research about eating patterns.

**4. 'What does this study involve?'**
If you choose to participate in this study, you will be required to take part in ten [10] days of monitoring (explained below).

While in the study, we will monitor your eating/drinking patterns and your feelings/experiences as you go about your daily life. To do this, you will be supplied with a simple to use hand-held computer - similar in appearance to a mobile telephone. You will need to return this device at the end of the study. You will be asked to carry this device with you for the duration of the ten [10] day study. Each day you will be asked to carry the device with you wherever you go and to record

each time you consume a meal, snack, or drink. Some of these consumption recordings will be selected at random to be followed up with a brief assessment survey consisting of questions asking about the social, emotional, and situational context of the eating episode. You will also be asked to complete 4-5 assessments at random times throughout your waking day. Each assessment will take approximately 1-2 minutes to complete. Study staff will provide training on how to use the study device and will be able to answer any questions that you might have regarding study participation.

Your participation will require you to visit the University of Tasmania up to three [3] times for study visits: once to enrol (allow approx. 45 minutes); and for two [2] brief (approx. 15 minute) visits, once around day three [3] of your participation, and a final visit around day ten [10]. During the enrolment visit, you will receive training on how to use the study device. You will also be asked to complete some baseline surveys to help us gather some background information on your current/previous health behaviours, and the researcher will conduct an assessment of your current BMI. At visit two [2], your study data will be downloaded from your study device so this data can be reviewed, and some additional training may occur if necessary. During visit three [3], you will return the study device, and receive some debriefing regarding your experience in the study. You will also be reimbursed $40 for your time and contribution to the research.

It is important you understand that your involvement is this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences to you if you decide not to participate. If you decide to discontinue participation at any time, you may do so without providing an explanation. All information will be treated in a confidential manner, and your name will not be used in any publication arising out of the research. All of the research will be kept in a locked cabinet School of Pharmacy, and on a password protected computer. Hard copy data will be kept for at least five (5) years from the date of the first publication of the study results. Electronic data will be securely stored until it is no longer necessary.

**5. Are there any possible benefits from participation in this study?**
It is possible that the monitoring methodology used in this study will help you gain some useful insight into your individual eating/drinking habits and experiences. Furthermore, the information we gather may be beneficial to other people by contributing to development of future weight management interventions.

**6. Are there any possible risks from participation in this study?**
There are no specific risks anticipated with participation in this study.

**7. What if I have questions about this research?**
If you would like to discuss any aspect of this study please feel free to contact Chief Investigator Stuart Ferguson on 6226 8536, or at Stuart.Ferguson@utas.edu.au. Stuart would be happy to discuss any aspect of the research with you. When the study has been finalized, the main outcomes will be published on the UTAS Psychology website.

This study has been approved by the Tasmanian Social Science Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0012474].

**Thank you for taking the time to consider this study.**

**If you wish to take part in it, please sign the attached consent form.**

**This information sheet is for you to keep.**

# Appendix G

## Consent form

CONSENT FORM

Title of Project: ANTECEDENTS AND CONSEQUENCES OF EATING AND THEIR ROLE IN OBESITY

---

1. I have read and understood the 'Information Sheet' for this project.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves ten [10] days of monitoring (explained below). While in the study, I will be asked to monitor my eating/drinking patterns and my emotional experiences using a simple to use hand-held computer. I understand I will be asked to carry this device with me at all times for the duration of the ten [10] day study.

   I understand that I will be required to visit the University of Tasmania up to three [3] times for study visits: once to enrol (this visit); and two [2] brief (approx. 15 minute) visits, once around day three [3] of my participation, and a final visit around day ten [10].

   Finally, I understand that if I complete the entire study I will receive $40 as compensation for my time.
4. I understand that there are no risks anticipated from my participation in this research
5. I understand that all research data will be securely stored on the University of Tasmania premises for at least five years, and will then be destroyed when no longer required.
6. Any questions that I have asked have been answered to my satisfaction.
7. I agree that research data gathered from me for the study may be published provided that I cannot be identified as a participant.
8. I understand that the researchers will maintain my identity confidential and that any information I supply to the researcher(s) will be used only for the purposes of the research.
9. I agree to participate in this investigation and understand that I may withdraw at any time without any effect, and if I so wish, may request that any data I have supplied to date be withdrawn from the research.

---

Name of Participant: _____

Signature: _____ Date: _____

**Statement by Investigator**

☐ I have explained the project & the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have the opportunity to contact me prior to consenting to participate in this project.

Name of investigator _____

Signature of investigator _____ Date _____

# Appendix H

## EMA program questions

# Questionnaire: Wakeup Report

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| 1 | Question | Good Morning! How long ago did you wake up? | Push Button (pick one) | <15 mins, 15 - 30 mins, 30 - 60 mins, >60 mins | |
| | Header | SINCE LAST EVENING REPORT: | | | |
| 2 | Question | Meals consumed but NOT yet entered? | Spinner | 0-10+ | |
| 3 | Question | Snacks consumed but NOT yet entered? | Spinner | 0-10+ | |
| 4 | Question | Drinks consumed but NOT yet entered | Spinner | 0-10+ | |
| 5 | Question | Food craving? | Slider | 0-100 (with No!!-Yes!! anchors) | |

# Main Menu: Meal log

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| 1 | Question | Meal | Push Button (pick one) | Breakfast, lunch, dinner | Proceed to following questions for all options of 1e |
| 2 | Question | What type of breakfast? | Push Button (pick all that apply) | Bread, Cereal, Eggs, Yoghurt, Fruit, Meat, Other | Ask only if 1e=breakfast |
| 3 | Question | What type of lunch? | Push Button (pick all that apply) | Sandwich/roll, Pasta/noodles, Salad, Soup, Fast Food, Sushi, Other | Ask only if 1e=lunch |
| 4 | Question | What type of dinner? | Push Button (pick all that apply) | Bread/roll, Pasta/rice, Salad, Vegetables, Meat, Fast food, Other | Ask only if 1e=dinner |
| 5 | Question | Consumed a drink with your meal? | Push Button (pick one) | Yes, No | |
| 6 | Question | What type of drink | Check Box (all that apply) | Caffeine, Alcohol, Energy drink, Other (water, milk, juice etc) | Ask only if 5e=yes |
| 7 | Question | How many drinks in last 15 minutes? | Spinner | 1-5+ | Ask only if 6e=drinking alcohol |
| 8 | Question | Intoxicated/drunk? | Slider | 0-100 (with No!!-Yes!! anchors) | Ask only if 6e=drinking alcohol |
| | Instruction | Remaining items refer to the situation where you first decided to eat | | | |
| | Header | FEELING: | | | |
| 9 | Question | Alert? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 10 | Question | Angry/frustrated? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 11 | Question | Bored? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 12 | Question | Calm/relaxed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 13 | Question | Able to focus? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 14 | Question | Happy? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 15 | Question | Irritable? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 16 | Question | Stressed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 17 | Question | Restless? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 18 | Question | Sad? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 19 | Question | Energy level? | Push Button (pick one) | Very low, Low, Moderate, High, Very high | |
| 20 | Question | Overall feeling? | Push Button (pick one) | Very bad, Bad, Neutral, Good, Very good | |
| | Header | WHEN YOU DECIDED TO EAT: | | | |

| | | | | | |
|---|---|---|---|---|---|
| 21 | Question | Location? | Push Button (pick one) | Home, Workplace, Other's home, Bar, Restaurant, Vehicle, Outside, Other | |
| 22 | Question | Food available? | Check Box (all that apply, but see note) | None, Confectionery, Savoury, Dairy, Biscuits/cakes/pastries, Fast food, Other | Don't allow No + any other option |
| 23 | Question | With others? | Check Box (all that apply, but see note) | Alone, Friends, Acquaintances, Family members, Co-workers, Romantic partner | Don't allow Alone + any other option |
| 24 | Question | People eating? | Check Box (all that apply, but see note) | No, In my group, In view | Don't allow No + any other option |
| 25 | Question | Activities? | Check Box (all that apply) | Working/chores, Inactive/leisure, Interacting with others, Between activities, Other activities | |
| 26 | Question | Type of work? | Push Button (pick one) | Job, School, House/Personal, Other | Ask only if 25e=Working/chores |
| 27 | Question | Type of inactivity/leisure? | Push Button (pick one) | Media, Hanging out, Hobbies, Sports/Exercise, Reading, Waiting, Doing nothing, Other | Ask only if 25e=inactivity/leisure |
| 28 | Question | Type of interaction with others? | Push Button (pick one) | Socializing, For business, Household issues, Arguing, Other interaction | Ask only if 25e=interacting with others |

# Main Menu: Snack log

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| 1 | Question | Snack | Push Button (pick one) | Confectionery, Savoury, Fruit/Nuts, Dairy, Biscuits/cakes/pastries, Fast food, Other | Only proceed with following questions if report energy rich snacks (confectionery, savoury, biscuits/cakes/pastries, fast food) |
| | Instruction | Remaining items refer to the situation where you first decided to eat | | | |
| | Header | FEELING: | | | |
| 2 | Question | Alert? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 3 | Question | Angry/frustrated? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 4 | Question | Bored? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 5 | Question | Calm/relaxed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 6 | Question | Able to focus? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 7 | Question | Happy? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 8 | Question | Irritable? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 9 | Question | Stressed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 10 | Question | Restless? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 11 | Question | Sad? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 12 | Question | Energy level? | Push Button (pick one) | Very low, Low, Moderate, High, Very high | |
| 13 | Question | Overall feeling? | Push Button (pick one) | Very bad, Bad, Neutral, Good, Very good | |
| | Header | WHEN YOU DECIDED TO EAT: | | | |
| 14 | Question | Location? | Push Button (pick one) | Home, Workplace, Other's home, Bar, Restaurant, Vehicle, Outside, Other | |
| 15 | Question | Food available? | Check Box (all that apply, but see note) | None, Confectionery, Savoury, Dairy, Biscuits/cakes/pastries, Fast food, Other | Don't allow No + any other option |
| 16 | Question | With others? | Check Box (all that apply, but see note) | Alone, Friends, Acquaintances, Family members, Co-workers, Romantic partner | Don't allow Alone + any other option |
| 17 | Question | People eating? | Check Box (all that apply, but see note) | No, In my group, In view | Don't allow No + any other option |

| | | | | | |
|---|---|---|---|---|---|
| 18 | Question | Activities? | Check Box (all that apply) | Working/chores, Inactive/leisure, Interacting with others, Between activities, Other activities | |
| 19 | Question | Type of work? | Push Button (pick one) | Job, School, House/Personal, Other | Ask only if 18e=Working/chores |
| 20 | Question | Type of inactivity/leisure? | Push Button (pick one) | Media, Hanging out, Hobbies, Sports/Exercise, Reading, Waiting, Doing nothing, Other | Ask only if 18e=inactivity/leisure |
| 21 | Question | Type of interaction with others? | Push Button (pick one) | Socializing, For business, Household issues, Arguing, Other interaction | Ask only if 18e=interacting with others |

# Main Menu: Drink log

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| 1 | Question | Drink | Push Button (pick one) | Caffeine, Alcohol, Energy drink, Other (water, milk, juice etc) | *ONLY proceed to rest of questions if report drink with high energy content (i.e. if report caffeine/alcohol/energy drink) |
| | Header | ABOUT THIS DRINK EPISODE: | | | |
| 2 | Question | How many standard drinks? | Spinner | 0-10+ | Ask only if 1e=alcohol |
| 3 | Question | Intoxicated/drunk? | Slider | 0-100 (with No!!-Yes!! anchors) | Ask only if 1e=alcohol |
| | Instruction | Remaining items refer to the situation where you first decided to drink | | | |
| | Header | FEELING: | | | |
| 4 | Question | Alert? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 5 | Question | Angry/frustrated? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 6 | Question | Bored? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 7 | Question | Calm/relaxed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 8 | Question | Able to focus? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 9 | Question | Happy? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 10 | Question | Irritable? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 11 | Question | Stressed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 12 | Question | Restless? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 13 | Question | Sad? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 14 | Question | Energy level? | Push Button (pick one) | Very low, Low, Moderate, High, Very high | |
| 15 | Question | Overall feeling? | Push Button (pick one) | Very bad, Bad, Neutral, Good, Very good | |
| | Header | WHEN YOU DECIDED TO DRINK: | | | |
| 16 | Question | Location? | Push Button (pick one) | Home, Workplace, Other's home, Bar, Restaurant, Vehicle, Outside, Other | |
| 17 | Question | Food available? | Check Box (all that apply, but see note) | None, Confectionery, Savoury, Dairy, Biscuits/cakes/pastries, Fast food, Other | Don't allow No + any other option |
| 18 | Question | With others? | Check Box (all that apply, but see note) | Alone, Friends, Acquaintances, Family members, Co-workers, Romantic partner | Don't allow Alone + any other option |
| 19 | Question | People drinking? | Check Box (all that apply, but see note) | No, In my group, In view | Don't allow No + any other option |

| | | | | | |
|---|---|---|---|---|---|
| 20 | Question | Activities? | Check Box (all that apply) | Working/chores, Inactive/leisure, Interacting with others, Between activities, Other activities | |
| 21 | Question | Type of work? | Push Button (pick one) | Job, School, House/Personal, Other | Ask only if 20e=Working/chores |
| 22 | Question | Type of inactivity/leisure? | Push Button (pick one) | Media, Hanging out, Hobbies, Sports/Exercise, Reading, Waiting, Doing nothing, Other | Ask only if 20e=inactivity/leisure |
| 23 | Question | Type of interaction with others? | Push Button (pick one) | Socializing, For business, Household issues, Arguing, Other interaction | Ask only if 20e=interacting with others |

# Questionnaire: Random Prompts

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| | Instruction | ABOUT YOUR LAST FOOD/DRINK: | | | |
| 1 | Question | How long ago did the event occur? | Push Button (pick one) | 0-10 mins, 10-30mins, 30-60 mins, 1-2hours, 2-3 hours, >3hours | |
| 2 | Question | Was the food/drink satisfying? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 3 | Question | Was the food/drink enjoyable/pleasing? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 4 | Question | How much did you consume? | Push Button (pick one) | More than usual, Same as usual, less than usual | |
| | Header | RIGHT NOW: | | | |
| 5 | Question | Alert? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 6 | Question | Angry/frustrated? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 7 | Question | Bored? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 8 | Question | Calm/relaxed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 9 | Question | Able to focus? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 10 | Question | Happy? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 11 | Question | Irritable? | Slider | 0-100 (with No!!-Yes!! anchors) | |

| | | | | | |
|---|---|---|---|---|---|
| 12 | Question | Stressed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 13 | Question | Restless? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 14 | Question | Sad? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 15 | Question | Energy level? | Push Button (pick one) | Very low, Low, Moderate, High, Very high | |
| 16 | Question | Overall feeling? | Push Button (pick one) | Very bad, Bad, Neutral, Good, Very good | |
| | Header | RIGHT NOW: | | | |
| 17 | Question | Location? | Push Button (pick one) | Home, Workplace, Other's home, Bar, Restaurant, Vehicle, Outside, Other | |
| 18 | Question | Food available? | Check Box (all that apply, but see note) | None, Confectionery, Savoury, Dairy, Biscuits/cakes/pastries, Fast food, Other | Don't allow No + any other option |
| 19 | Question | With others? | Check Box (all that apply, but see note) | Alone, Friends, Acquaintances, Family members, Co-workers, Romantic partner | Don't allow Alone + any other option |
| 20 | Question | People eating? | Check Box (all that apply, but see note) | No, In my group, In view | Don't allow No + any other option |
| 21 | Question | Activities? | Check Box (all that apply) | Working/chores, Inactive/leisure, Interacting with others, Between activities, Other activities | |
| 22 | Question | Type of work? | Push Button (pick one) | Job, School, House/Personal, Other | Ask only if 21e=Working/chores |

| | | | | | |
|---|---|---|---|---|---|
| 23 | Question | Type of inactivity/leisure? | Push Button (pick one) | Media, Hanging out, Hobbies, Sports/Exercise, Reading, Waiting, Doing nothing, Other | Ask only if 21e=inactivity/leisure |
| 24 | Question | Type of interaction with others? | Push Button (pick one) | Socializing, For business, Household issues, Arguing, Other interaction | Ask only if 21e=interacting with others |
| 25 | Question | Would you like to eat right now but think that you shouldn't? | Slider | 0-100 (with No!!-Yes!! anchors) | |

# Questionnaire: Evening Report

| Q# | Type of Data | Text | Response type | Response options | Notes / Skip Patterns |
|---|---|---|---|---|---|
| | Header | SINCE LAST EVENING REPORT: | | | |
| 1 | Question | How many meals consumed today? | Spinner | 0-10+ | |
| 2 | Question | How many snacks consumed today? | Spinner | 0-10+ | |
| 3 | Question | How many drinks consumed today? | Spinner | 0-10+ | |
| 4 | Question | Found yourself craving food at any stage? | Slider | 0-100 (with No!!-Yes!! anchors) | If yes, go to 5e then 6 e |
| 5 | Question | Was the craving intense? | Slider | 0-100 (with No!!-Yes!! anchors) | Only ask if answer 4e=yes, proceed to 6 |
| 6 | Question | What type of food were you craving? | Push Button (pick one) | Confectionery, Savoury, Dairy, Biscuits/cakes/pastries, Other | Only ask if answer 4e=yes |
| 7 | Question | Overall feeling | Push Button (pick one) | Very bad, Bad, Neutral, Good, Very good | |
| 8 | Question | Energy level? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 9 | Question | Able to control important things? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 10 | Question | Able to handle personal problems? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 11 | Question | Nervous / stressed? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 12 | Question | Things going your way? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 13 | Question | Unexpected things upset you? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 14 | Question | Upset by things outside of your control? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 15 | Question | Meals consumed but NOT yet entered? | Spinner | 0-5+ | |
| 16 | Question | Snacks consumed but NOT yet entered? | Spinner | 0-10+ | |
| 17 | Question | Drinks consumed but NOT yet entered? | Spinner | 0-10+ | |
| 18 | Question | Felt like eating but didn't'? | Slider | 0-100 (with No!!-Yes!! anchors) | |
| 19 | Question | Exercised today? | Push Button (pick one) | No, Yes | |
| 20 | Question | How long did you exercise for? | Push Button (pick one) | 2hours, 2-3 hours,>3hours | *ask only if 19e=yes |

# Appendix I

## Data CD

Please see enclosed CD attached on the back cover.